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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/975,256	10/12/2001	Krishnaswamy Ramkumar	8229-014-27	8851

7590

06/11/2003

Supervisor, Patent Prosecution Services
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Washington, DC 20036-2412

EXAMINER

HOGANS, DAVID L

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 06/11/2003

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Applicati n N .

09/975,256

Examiner

David L. Hogans

Applicant(s)

RAMKUMAR ET AL.

Art Unit

2813

-- The MAILING DATE of this communication appears n the c ver sheet with th correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 April 2003 .
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disp sition of Claims

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 12 October 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Pri rity under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____ .

DETAILED ACTION

This Office Action is in response to Amendment B filed on April 11, 2003.

Status of Claims

Claims 1-23 are pending.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1-10, 13-14 and 18-23 are rejected under 35 U.S.C. 102(e) as being anticipated by 6,479,349 to Oya et al.

In reference to Claims 1 and 19, Oya et al. teaches:

- forming an oxide layer (12 and/or 15) on a substrate (1) by oxidizing the substrate in a CVD furnace (See Figures 1-12 and column 6 lines 50-65)
- introducing nitric oxide into the CVD furnace and nitriding the oxide layer at 800 °C and at a pressure less than 1 atm (See columns 6-7 lines 65-30, column 9 lines 25-35 and 60-65, column 10 lines 59-68 and column 11 lines 19-31)

In reference to Claim 2, Oya et al. teaches:

Art Unit: 2813

- performing the oxide and nitriding steps at approximately the same temperature
(See column 6 lines 55-65 and column 9 lines 25-35 and 60-65)

In reference to Claims 3-5, Oya et al. teaches:

- performing the oxide and nitriding steps at a pressure less than 1.0 atm (See column 6 lines 54-61, column 10 lines 19-32 and column 10 lines 59-65)

In reference to Claim 6, Oya et al. teaches:

- performing the oxide and nitriding steps at 800 °C (See column 6 lines 55-65 and column 9 lines 25-35 and 60-65)

In reference to Claims 7 and 20, Oya et al. teaches:

- performing a second oxidation step after the nitriding step (See column 10 lines 33-50)

In reference to Claims 8-10 and 22, Oya et al. teaches:

- depositing a polysilicon gate electrode layer over the nitrided oxide layer with a tungsten silicide layer (See columns 7-8 lines 65-05)

In reference to Claims 13 and 14, Oya et al. teaches:

- a silicon substrate and a silicon oxide layer formed from an oxygen containing gas (See column 6 lines 50-65)

In reference to Claims 18 and 21, Oya et al. teaches:

- depositing a gate electrode layer on top of the oxidized nitrided gate oxide layer
(See column 11 lines 19-31)

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 11, 12 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over 6,479,349 to Oya et al. in view of Applicant's own admitted prior art.

Incorporating all arguments of Claims 1, 8, 11, 19 and 22 and noting that Oya et al. fails to explicitly teach doping the gate electrode with a dopant or more specifically, boron.

However, Applicant's own admitted prior art, specification pages 1-2 lines 16-01, teaches boron doping of polysilicon gate electrodes of MOS devices. Further, the Applicant points out that polysilicon gate electrodes doped with boron exhibit reduced short-channel effects, lower threshold voltages and adequate conductance.

It would have been obvious to one of ordinary skill in the art to modify Ova et al. by incorporating boron doping of polysilicon gates, as admitted by Applicant as prior art, to reduce short-channel effects, lower threshold voltages and ensure adequate conductance of the gate electrode.

5. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over 6,479,349 to Oya et al in view of 6,323,094 to Wu.

Incorporating all arguments of Claim 1 and noting that Oya et al. fails to explicitly teach an oxide layer having a thickness 15 angstroms or less.

However, Wu, in columns 3-4 lines 67-26, teaches a gate oxide of 10 angstroms. Further, Wu teaches one can employ an ultra thin gate oxide because nitrided gate oxide layers exhibit better properties, such as, improved gate reliability for suppressing boron penetration.

It would have been obvious to one of ordinary skill in the art to modify Oya et al. by incorporating a nitrided gate oxide thickness of 10 angstroms, as taught by Wu, to suppress boron penetration and to increase transistor speed by reducing dimensions.

6. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over 6,479,349 to Oya et al.

Incorporating all arguments of Claim 1 and noting that Oya et al. discloses the claimed invention except for the oxide layer containing at least 1.5 wt.% of nitrogen. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to optimize the range of nitrogen content in the oxide layer, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (CCPA 1955)

Furthermore, as Oya et al. teaches the process conditions proposed by Applicant (i.e. – nitric oxide, pressure less than 1 atm and temperatures of 800 °C), it logically follows that the same results are obtained (i.e. – an oxide layer with at least 1.5 wt.% nitrogen).

7. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over 6,479,349 to Oya et al in view of Microchip Fabrication to Van Zant.

Incorporating all arguments of Claim 1 and noting that Oya et al. fails to teach wherein the oxide layer is a dry oxide layer.

However, Van Zant, on pages 172-173, teaches formation of an oxide layer by a dry oxide process. Furthermore, Van Zant teaches that dry oxidation is the preferred general oxidation method for production of all advanced devices.

It would have been obvious to one of ordinary skill in the art to modify Oya et al. by incorporating formation of an oxide layer by dry oxidation, as taught by Van Zant, because dry oxidation is the preferred general oxidation method.

Response to Arguments

8. Applicant's arguments filed April 11, 2003, have been fully considered but they are not persuasive.

Initially, the Examiner notes the Applicant's distinction between nitrous oxide and nitric oxide. The Examiner is uncertain how the Office Action of January 23, 2003, is unclear as to these terms because the Office Action unequivocally states that 6,479,349 to Oya et al. teaches introducing nitric oxide (NO) into a CVD furnace for nitriding an oxide layer. For further elucidation please see the rejection for Claims 1-10, 13-14 and 18-23 and the corresponding citations.

Secondarily, the Applicant portends that a diffusion furnace is not the same as a CVD furnace. The Examiner need not address the temperature limitations proposed by the Applicant because the cited reference clearly teaches performing the nitric oxide

Art Unit: 2813

oxidation at 800 °C (See the rejection for Claim 19). As to the proposed distinction between a diffusion furnace and a CVD furnace, the Examiner notes that it is well known within the art that a diffusion furnace and a CVD furnace are equivalent. Furthermore, the Examiner notes that 6,479,349 to Oya et al., in column 10 lines 59-65, discloses nitric oxide nitridation in a LPCVD furnace.

Third, the Applicant portends that 6,479,349 to Oya et al. fails to teach all the elements of Claims 1-10, 13-14 and 18-23. The Applicant proffers this notion by rewriting the independent Claims 1 and 19 and stating that 6,479,349 to Oya et al. fails to anticipate the claims. As to this argument, the Examiner refers Applicant to the rejections above for Claims 1 and 19. The examiner maintains that 6,479,349 to Oya et al. teaches all of Applicant's claimed elements. The Examiner particularly notes column 11 lines 19-31 of 6,479,349 to Oya et al., as it clearly denotes the concept that the before described process can be applied to gate insulating films.

Finally, the Applicant portends that the cited references fail to teach all the elements of Claims 11, 12, 15-17 and 23. The extent of the Applicant's argument is that the additionally cited references fail to cure the deficiencies of 6,479,349 to Oya et al. As such, the Examiner again refers the Applicant to the rejection for Claims 1 and 19.

Conclusion


9. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David L. Hogans whose telephone number is (703) 305-3361. The examiner can normally be reached on M-F (7:30-4:30).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr. can be reached on (703) 308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1782.


CARL WHITEHEAD, JR.
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800

Application/Control Number: 09/975,256
Art Unit: 2813

Page 10

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June 3, 2003